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Lightning Creates A Virginia Fulgurite

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A blinding streak of light accompanied by a tremendous clap of thunder and 100 million volts of electricity link heaven and earth for a terrifying second. Geologic evidence of one particular lightning strike is known from Pine Moun-

tain in Dickenson County, Virginia. The site of this strike is underlain by the Lee Sandstone, a Pennsylvanian-age sedimentary rock made up of sand-sized grains of quartz (SiO_2). The sandstone has weathered enough locally to

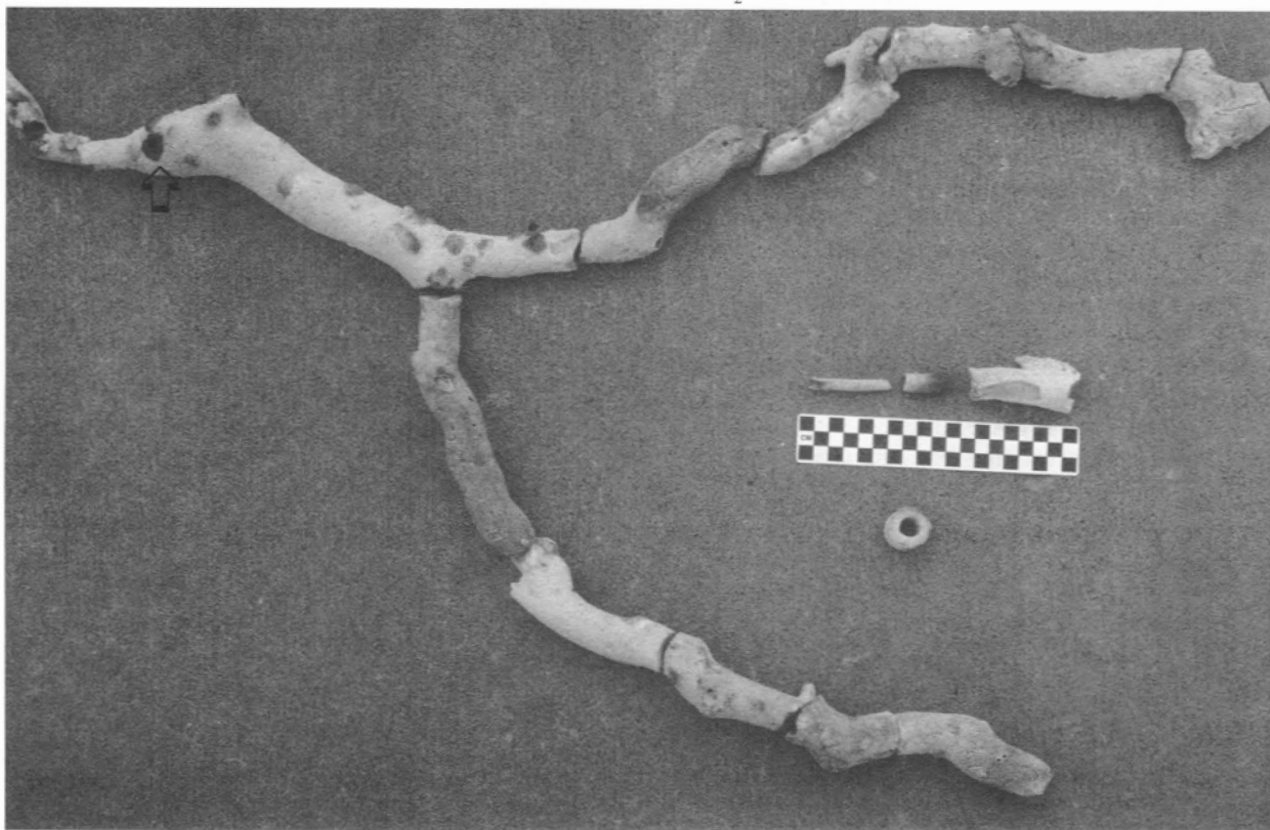


Figure 1. Reconstructed fulgurite. Centimeter scale is about 7.5 inches long (2.54 cm = inch). Three different size fulgurite segments shown above centimeter-scale. The doughnut-like transverse section of fulgurite tube turned on end below centimeter-scale would attach to the end of the upper right branch. Arrow points to dark spot where lightning bolt probably began the fulgurite with the major fraction of the strike travelling to the right.

be covered by as much as a foot of quartz sand. At the site, the electrical current coursed a molten path through the sandy soil and created a permanent record of its passing: a fulgurite.

A *fulgurite* is defined by Mitchell (1985) as an: "Irregular, glassy tube or crust produced by the fusion of loose sand (or rarely, compact rock) by lightning strokes; common in sand dunes on shores and deserts and on exposed mountain tops." A description of how a fulgurite forms is provided by Rakov (1999): "When lightning strikes sandy soil, the air and moisture present in soil are rapidly heated, and the resultant explosion-like expansion forms the central tubular void....quartz sand melts at a temperature of about 1600-2000° C depending on moisture content, and molten glass is pushed to the periphery of the void. Subsequent relatively rapid cooling causes the glass to solidify." This natural glass, formed from a silica source, is known as *lechatelierite*.

The Pine Mountain fulgurite consists of branching glassy tubes (Figure 1) between 5/16 and 1" - inches in diameter with an opening of 3/16 to 9/16 of an inch. Tube thickness ranges from less than a 1/16 of an inch in the pencil sized tubes, to as much as 5/16 of an inch in the inch diameter segments. The internal details of the intact 9 - inch long, 1" - inch diameter segment are unknown. Approximately four feet of inch diameter tube, with an internal opening averaging a half-inch in diameter, was recovered. Viewed under a 10 - power hand-lens in reflected light, the innermost wall of a typical tube cross-section is comprised of a frothy glass grading through a bubbly glass to a glass with few bubbles with a fused sand exterior. What appear to be partially melted grains were observed in increasing density from about the midpoint to the outer margin of a transverse section of the translucent glass. The glass contains occasional black inclusions of carbon. A few quartz pebbles are noticeable along the exterior of individual tube segments (Figure 2).

Microscopic observation of a thin-section of tube wall reveals the presence of elongate bubbles. The bubbles extend from the interior wall with a decrease in bubble size and density from the interior to the exterior wall. No crystalline structure is observed except in quartz grains fused to the external margin of the tube. Grain-like struc-

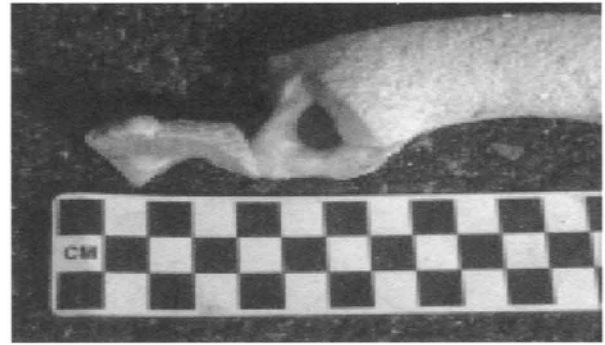


Figure 2. Close-up of broken segment of fulgurite with hollow central core visible. Nearly half-inch (2.54 cm = inch) quartz pebble on outer margin of fragment to left side. Most of pebble was melted into silica glass comprising the wall of the hollow fulgurite.

tures that look like partially melted grains under hand lens magnification, have no crystalline structure. These features may be "ghosts" of individual grains that melted in place as the superheated glass melt was expansively expelled from the path of the electrical charge to surround peripheral grains.

X-ray analysis of a fragment of fulgurite revealed an amorphous glass with only a trivial presence of quartz. This trace of quartz is consistent with the presence of quartz grains fused to the external margin of the tube fragment. These X-ray results confirm that the silica melt cooled much too rapidly for a crystalline structure to develop.

What type of rock is a fulgurite? It is not a sedimentary rock. It could be considered an igneous rock, because it solidified from molten material. It could be a metamorphic rock, despite the fact that the thermal alteration occurred within what we would call the zone of weathering and cementation.

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